Management of perioperative stress in children and parents. Part II — anaesthesia and postoperative period

Jacek Litke, Agnieszka Pikulska, Tomasz Wegner

Department of Anaesthesiology and Intensive Therapy, Pomerania Medical University in Szczecin

ABSTRACT
The majority of children, even those well prepared and with positive attitudes, experiences stress in the operating theatre and during the postoperative period. In some cases, the stress is even stronger for their parents. The role of anaesthetists is to minimize the unpleasant sensations by providing painless vein cannulation, uneventful induction of anaesthesia, suitably planned and timed analgesia, and prevention of postoperative vomiting. The effectiveness of combined analgesics, early administration of saturating doses and analgesia supplemented or based on methods of block anaesthesia – particularly on peripheral and local blocks, less appreciated in children, have been highlighted. Such a stress-reducing strategy should be initiated before hospitalisation and consistently continued to its completion or even longer, the example of which are one-day surgery patients who should receive prescriptions for or suitable drugs (mainly analgesics) on discharge for use in the home setting. Preparation of local programmes for management reducing surgery-associated stress in children is worth recommending.

Key words: perioperative medicine, surgery; surgery, anaesthesia, children; postoperative pain; postoperative nausea and vomiting; anaesthesia, children, anxiety


In the first part, we discussed several preoperative problems and possibilities to reduce stress in children and their parents during preparation for anaesthesia and surgery. Some further methods of management of surgery-related stress in children were addressed to in the present part.

VEIN CANNULATION
Vein cannulation before diagnostic or surgical procedures in children can be extremely stressful for children, parents and medical staff. However, once certain rules are followed, the procedure-related experiences are likely to be less severe.

Anxiety and agitation can markedly hinder the insertion of intravenous cannula; therefore, the procedures should be postponed until the child has been adapted to the surroundings. Haste should be avoided and local skin anaesthetic creams routinely used. The abandonment of local anaesthesia before elective procedures is unjustified. In Poland, the EMLA cream is available (AstraZeneca AB, Sweden), which is the mixture of lidocaine and prilocaine. In some countries, the Ametop gel (Smith&Nephew, Great Britain) can be used [1, 2, 3, 4]. The cream has to be applied according to the manufacturer’s instructions, preferably over two areas with visible veins, e.g. on dorsal area of both hands. The application site should be chosen by the physician or experienced nurse. Unsuccessful cannulation of one vein does not delay the surgery.

The optimal solution is to provide an intravenous access when the effects of skin local anaesthesia and pharmacological premedication have been observed. The personnel should be trained how to apply the EMLA cream to avoid possible mistakes (too thin layer, improper place, too early removal or smudging by a child, too short time of application). In some cases, despite appropriate and professional proceedings, intravenous access-related stress is unavoidable and inhalation induction of anaesthesia is considered the “best choice evil” [5].

PARENTAL PRESENCE DURING INDUCTION OF ANAESTHESIA
The presence of parents during vein cannulation and induction of anaesthesia is disputable [6, 7]. In many coun-
tries, parents accompany their children during these procedures. According to the study comparing the calming effects of midazolam and parental presence, pharmacological premedication was found more beneficial [8]. On the other hand, parental presence allows to avoid dramatic experiences associated with forced separation, which can lead to subsequent psychosomatic disorders [9, 10]. The majority of children demonstrate lower levels of anxiety when accompanied by parents, particularly when both children and parents were earlier suitably prepared and informed. The severity of separation-attributable stress differs in individual children and depends on age, individual predispositions, personality, past experiences, and the level of everyday parents’ care. The children whose parents devoted them less time and did not satisfy their emotional needs, react with more severe anxiety during separation with parents or caregivers.

There are however cases in which the presence of family members does not improve communication and cooperation between the physician and the child, which mainly regards highly anxious and emotionally unstable parents. During cooperation with such parents, anaesthesiologists should remember that they are also responsible for them, which in some cases can be troublesome, e.g. parent fainting or collapsing. Therefore, before the parents are invited to stay with their children during invasive procedures, they should be asked whether they are able to manage emotionally. When their answer is yes, further cooperation is likely to alleviate the level of stress in all individuals involved and to facilitate the procedures. Moreover, the level of stress can be lowered when the children are allowed to keep their favourite toys or avoid noise and too many personnel members may also prove beneficial.

During intravenous induction, which is highly recommended, parental presence ends once the child has fallen asleep. This particular moment often arouses intensified emotions in parents and is the best time to leave their child under the anaesthetist attendance. The parental presence during further procedures — endotracheal intubation, placement of a laryngeal mask airway or regional anaesthesia — is not recommended. However, their presence in the recovery room when the child recovers from anaesthesia is extremely important.

In Poland, parents are often reluctantly allowed to be present during the induction of anaesthesia or early postoperative period, which is reasonless; especially that parental presence does not require special organisational or financial measures. We should remember about the parental rights and realise that the admitted child does not become a “property” of the health care institution.

**POSTOPERATIVE PAIN**

Proper management of postoperative pain in children is still a serious problem in many surgical departments. Despite the findings of multi-centre studies published in the 80ties and 90ties of the previous century regarding assessment and treatment of pain in paediatric patients, some physicians still believe that young children, neonates in particular, do not feel pain, as their nervous systems are immature due to incomplete myelination of nervous fibres.

Pain always accompanies therapy; the goal of physicians should be to recognize the pain and eliminate it. The medical staff should attend regular trainings and learn that pain management is one of the pivotal elements determining the patient’s recovery. The alleviation of pain accelerates the healing of postoperative wounds, reduces physiological perioperative stress and has beneficial effects on mental comfort of children, which results in shorter convalescence and rehabilitation. Considering the above, standards of paediatric pain management should be designed and implemented. Many factors affect improper pain treatment in children, e.g. financial or equipment shortages, imperfect methods of pain assessment in the youngest patients, poor work organisation, negative attitudes or lack of knowledge of physicians and nurses. Moreover, the ungrounded fears of using opioids (mainly morphine), reluctant use of paediatric regional anaesthesia (or lack of abilities to perform it), and lack of postoperative pain therapy programmes in certain hospitals are worth mentioning.

**RECOGNITION AND ASSESSMENT OF PAIN**

Proper assessment of pain is particularly difficult in younger children and psychomotor impaired patients, who cannot accurately describe their sensations. Pain accompanies children since the first moments of their lives. It is associated with standard care (vaccination), may be the symptom of acute or chronic illness, and is a part of learning about the surrounding world (cuts, sprains, fractures). Unfortunately, pain is also present during the hospital stay, where it should be properly recognised and treated. Proper pain assessment is essential for appropriate determination of its sources and implementation of suitable therapeutic strategies.

There are many methods to assess pain, which are adjusted to age and psychomotor development. None of them is ideal; in some cases, various tools are needed. Pain should be recognised, documented and treated as it induces many adverse phenomena, both of mental and physical nature. Pain can lead to haemodynamic instability, respiratory disturbances, difficult rehabilitation or prolonged wound healing. Once proper pain treatment has been started, efficacy should be continuously controlled in order to optimise the therapy and provide comfort.
Pain is classified according to various scales, depending on the child's age, type of procedure, place of stay (hospital, home) and duration. In children > 3 years of age, the postoperative pain is most commonly assessed using graphic scales, e.g. the faces pain scale (FPS), faces pain scale revised (FPS-R). In infants, pain is assessed with different scales, e.g. the neonatal facial coding scale (NFCS) or premature infant pain profile (PIPP). Older children can be evaluated using the visual analogue scale (VAS). Besides the evaluation reported by children, the parental aid is invaluable as parents can earlier recognise the pain-related anxiety in their children [11].

**TREATMENT OF POSTOPERATIVE PAIN IN CHILDREN**

The treatment of postoperative pain can be started with premedication; before anaesthesia and surgery, what is called pre-emptive analgesia. Besides sedatives, premedication may involve analgescics, which could be administered even by parents. This management is particularly useful in children admitted due to trauma or those undergoing short yet painful procedures.

In elective surgical procedures, it is recommended to treat perioperative pain with multimodal analgesia, which is based on the analgetic ladder i.e. combination of nonsteroidal anti-inflammatory drugs (NSAIDs) (ibuprofen, diclofenac, plus ketoprofen in older children) in the highest recommended doses and paracetamol or metamizole (also in the highest doses). These groups of drugs act synergistically as their mechanisms of action differ; therefore, their combined administration when used in loading doses is very effective. The preferable routes of administration are intravenous and/or rectal. An important element of severe pain management is intraoperative intravenous injection of long-acting opioids, usually morphine. Its use after the completion of surgery or several minutes earlier is found delayed and ineffective due to pharmacodynamic characteristics of the drug.

While planning the paediatric anaesthesia, regional blocks should be considered. Many hospitals linger on the opinion that regional anaesthesia considerably prolongs the whole surgery time. However, the benefits of proper central or peripheral blocks are significant and provide children with long-term postoperative comfort. They should be widely used for postoperative pain relief in children. Regional anaesthetic procedures enable to reduce markedly opioids requirement, reducing the risk or severity of their adverse side effects. Regional analgesia in children includes epidural, subarachnoid, intrapleural anaesthesias, plexus blocks and of nerve blocks.

In neonates and infants, sacral anaesthesia is the simplest method of central blocks with the lowest incidence of complications [12, 13]. Anaesthesia extent is predictable and postoperative analgesia efficient, particularly when using a low drug concentration in the high volume. Sacral anaesthesia is applied in various surgical procedures within the lower abdominal region, lower limbs and urogenital system. Noteworthy, the method is simpler and safer once needles designed for paediatric sacral anaesthesia are used.

In paediatric anaesthesia, blocks should be performed under general anaesthesia. It is recommended to identify the nerves and plexus using a stimulator and/or an ultrasound.

Thanks to the combination of general and regional anaesthesia, the concentrations of local anaesthetics can be low, which reduces the risk of their toxicity and does not induce long-term motor block. After recovery, small children badly tolerate motor block of limbs. In such cases, regional anaesthesia can paradoxically increase the severity of postoperative stress.

If regional anaesthesia is contraindicated or infeasible, infiltration anaesthesia of the wound should be considered, using long-acting local agents, e.g. bupivacaine usually administered administered during the final stage of surgery. The anaesthetist should ask surgeon to infiltrate the wound and should calculate the maximum dose of the drug.

In the postoperative period, further appropriate pain management cannot be neglected. Drugs should be used according to the ordered schedule, depending on drug pharmacokinetic and pharmacodynamic characteristics. Preferably, the protocols designed in a given hospital should be followed. The drugs should be chosen considering the route of administration, patient comfort, personnel experience, safety and possible adverse effects.

**NONSTEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS)**

Nonsteroidal anti-inflammatory drugs are effective in children for management of low- or moderate-severe pain [14]. Additionally, their action is anti-inflammatory and antipyretic. When combined with paracetamol, they produce an very good analgesic effect, better than that when administered separately. NSAIDs are especially recommended for management of pain following orthopaedic procedures. They are cheap, easily available, safe, and are produced in different forms, which is particularly important in children. Their wide range of formulations, which includes tasty syrups of various concentrations of active substances, suppositories, and intravenous injections, facilitates the proper choice of a drug and route adjusted to child's age, general attitude, and cooperation as well as staff comfort.

Due to their mechanism of action, the drugs can induce adverse effects even when the therapeutic doses have not been exceeded. The side effects include hypersensi-
tivity, decreased aggregation of platelets and prolonged bleeding, thus they are contraindicated in children with coagulation problems. Moreover, NSAIDs can impair the renal function, especially in dehydrated children and those with concomitant renal diseases. They are also likely to cause gastrointestinal bleedings, yet their risk is very low if used for a short time, up to 3 days. It has been speculated that NSAIDs enhance the symptoms of asthma; however, the findings of large studies demonstrated that short-term use of diclofenac and ibuprofen in asthmatic children was safe [15, 16, 17]. According to some animal studies, high doses of ketorolac resulted in delayed growth of bones, which was not conclusively confirmed by human studies [18].

NSAIDs should not be used for pain management in neonates due to insufficient autoregulation of the cerebral and pulmonary blood flow.

PARACETAMOL

Paracetamol is considered a weak analgesic. However, when combined with NSAID or codeine, it can be used to treat the moderate-intensity pain. There is a tendency to administer low doses of paracetamol due to exaggerated fear of hepatic failure, which is likely to be the reason of ungrounded opinions about its low efficacy.

In many countries, oral paracetamol is the major analgesic, often combined with other medications, depending on the severity of pain. Once administered orally, its maximum serum concentration is achieved after 30–60 min. Since the target place of its action is the central nervous system, the therapeutic effects are observed slightly later. Rectal route of paracetamol shows less predictable bioavailability, which is about 20% lower compared to oral administration. Therefore, higher loading doses are required, expect for neonates due to their decreased drug clearance, as well as higher bioavailability and distribution volume of the drug. Moreover, it should be remembered that rectal administration of paracetamol is contraindicated in patients with neutropenia because of the risk of sepsis.

The analgesic potency of intravenous paracetamol is higher but the infusion should last at least 15 minutes [19].

Even in its maximum doses (60 mg kg⁻¹ day⁻¹), paracetamol is well tolerated by children. Potential hepatotoxicity at overdosage > 150 mg kg⁻¹ and cautious dosing in or dehydrated children should be kept in mind.

METAMIZOLE

In Poland, metamizole is not registered for pain management in children, due to high risks of agranulocytosis, which can develop many weeks after its administration. Agranulocytosis develops due to idiosyncrasies, i.e. individual hypersensitivity; however, its risk is undeterminable. The metabolites of metamizole bind to neutrophils and are then recognized by the immune system as a foreign antigen, leading to production of antibodies, which destroy neutrophils and granulocyte line stem cells of bone marrow [2].

Another metamizole-attributable complication is the hypersensitivity reaction following intravenous administration, which can occasionally lead to anaphylactic shock.

OPIOIDS

Opioids are the most potent analgesics used for postoperative pain management. Their pharmacokinetics in children is similar to that observed in adults; in neonates and premature babies their clearance and protein binding are reduced whereas half-life prolonged.

The routes of opioid administration are various, including intravenous, oral, intramuscular, subcutaneous, epidural, subarachnoid and rectal. The drugs are safe when proper doses are used and patients supervised by the qualified personnel. One of the commonly used opioids is or should be morphine. This agent is cheap, its action long and potent. It addition to its analgesic effects, morphine induces moderate sedation, which is particularly beneficial for children during the postoperative period.

Opioids can be used in children in regular intravenous doses or or through the subcutaneous cannula. After major surgical procedures morphine can be administered in continuous infusion via infusion pump irrespective of child’s age; or as patient-controlled analgesia (PCA) in children under the age of in children over the age of 5 years. For patients too young to use the PCA pump, the nurse-controlled analgesia (NCA) can be applied. The long-acting opioids, such as morphine or less potent tramadol, are administered in loading doses during anaesthesia and surgery and later at regular intervals or in as continuous infusion in postoperative analgesia. The short-acting opioids, e.g. fentanyl, sufentanil, alfentanil or remifentanil are more commonly used in continuous infusion after extensive surgeries and in intensive therapy units.

Codeine and dihydrocodeine can be used for short-term management of medium-severity pain. Pethidine is not recommended in children due to seizure-inducing effects of its metabolite – norpethidine. Opioids have adverse side effects that should be prevented; if present, they have to be suitably assessed and proper management immediately implemented. Postoperative nausea and vomiting (PONV), in children PONV in fact, are one of the commonest side effects of opioids, although but their mechanism is generally more complex. PONV can be effectively prevented with antiemetic drugs; their treatment often requires combination of several drugs of various mechanisms of action.
PREVENTION AND TREATMENT OF POSTOPERATIVE NAUSEA AND VOMITING

DEXAMETHASONE

Dexamethasone is found effective for prevention and treatment of postoperative nausea and vomiting; the additional asset of its use is reduced morphine demand [21, 22]. This steroid reduces oedema resulting from surgical injury to the tissues, which diminishes the severity of inflammatory reaction to injury, hence alleviates pain. The mechanism of its antiemetic action has not been fully explained, most likely dexamethasone acts by centrally inhibiting the synthesis of prostaglandins, decreasing the breakdown of serotonin in the central nervous system or changing the blood-brain barrier permeability.

ONDANSETRON

The drug is a potent selective antagonist of 5-hydroxytryptamine type 3 (5-HT₃) receptors localized centrally in the chemoreceptor trigger zone chemoreceptor trigger zone and in the vagus nerve endings, in the nucleus of the solitary tract and peripherally in the intraparietal plexi of the gastrointestinal tract. Ondansetron inhibits nausea and vomiting, induced by serotonin released in the small intestine, and blocks the central 5-HT₃ receptors.

CONCLUSION

Perioperative stress in children can be limited at all stages of treatment and includes early preparation of children and parents, as well as pre- and postoperative management until discharge. The above goals are achievable once the medical teams and administrative employees are involved. Therefore, the individual centres should design their protocols of child and parent management covering the entire period of therapy. In the majority of cases, the introduction of beneficial strategies is not associated with higher expenditure but with administrative and logistics actions as well as proper personnel trainings.

References:

Corresponding author:
Jacek Litke MD, PhD
Department of Anaesthesiology and Intensive Therapy,
Pomeranian Medical University in Szczecin
ul. Uniwersytecka 1, 71–252 Szczecin
e-mail: jaclitke@life.pl

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